A NOTE ON UNSUCCESSFUL OVERWINTERING OF LARVAE OF *DANAUS PLEXIPPUS* (L.) (LEPIDOPTERA: NYMPHALIDAE) IN THE BLUE MOUNTAINS, NEW SOUTH WALES

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Abstract

Fortnightly observations were made on a larval population of *Danaus plexippus* (L.) at Hazelbrook, New South Wales to provide information on winter survival in the Blue Mountains. The population was decimated in July and August apparently by strong, cold winds. Only small numbers of larvae and pupae survived until September and none produced adult butterflies.

Introduction

The monarch or wanderer butterfly, *Danaus plexippus* (L.), has an extensive summer range in eastern Australia, breeding wherever suitable host plants occur (Smithers 1977). During autumn the southern part of this range (in NSW) contracts, forming overwintering populations in the Sydney and northern coastal areas of New South Wales. The Sydney basin harbours both breeding and non-breeding overwintering populations (Smithers 1965, James 1979, 1981). The westward limit of reproductive populations in the Sydney area has not been established, although larvae have not been recorded west of the Great Dividing Range during winter (Smithers 1977).

The two prime requirements for the survival and development of *D. plexippus* larvae are an adequate food supply and body temperatures greater than the developmental zero of 11-12°C for much of the time (Rawlins and Lederhouse 1981, Zalucki 1982). Milkweed, *Gomphocarpus* (= *Asclepias*) *fruticosus* (L) (Asclepiadaceae), the major host plant of *D. plexippus* in New South Wales, occurs at elevations of up to at least 700 m during winter in the Blue Mountains, west of the Sydney basin (James, unpub. obs.). The presence of host plants, together with the ability of *D. plexippus* larvae to increase body temperatures substantially when exposed to sunshine (James 1986), indicate that survival of larvae during winter in the Blue Mountains may be possible.

This study provides information on overwintering by larvae of *D. plexippus* during 1984 at one site in the Blue Mountains.

Materials and Methods

The author's garden at Hazelbrook, 17 km east of Katoomba at an altitude of 650 m, was chosen as the study site. A small patch of 25-30 milkweed plants, occupying an area of approximately 1 m^2, was established on a south-facing slope in December 1983. Plants ranged in size from, 0.5-1.5 m tall. The surrounding area was cultivated with vegetables. Natural bushland occurred 5 m down-slope of the milkweed.

On 26 May 1984, 100 second instar larvae of *D. plexippus* were introduced to the milkweed patch. One month later (24 June) a second batch of 100 third instar larvae was released. The milkweed was examined at fortnightly intervals until the end of September and data recorded on number and instar of larvae. Plants were searched thoroughly on each occasion and it is likely that only a small number of larvae escaped detection. Pupae found on the plants and general information on larval development and mortality were recorded. Weather conditions were recorded also; the ambient temperature was continuously monitored by a thermohygrograph situated 1 m above ground level.

Results

The population of 200 larvae introduced to the milkweed in early winter failed to produce a single butterfly. Numbers of larvae, fairly stable in June, declined dramatically during July and August (Table 1). Small numbers of pupae were produced but many were malformed and all died. The substantial depletion of larvae during July and August coincided with the occurrence of frequent cold and strong south to south-westerly winds which were often accompanied by rain, sleet or snow. Such weather systems often persisted for many days. The first of these severe cold fronts occurred in the first week of July. On 4 July snow covered the ground for more than 5 hours. Subsequent examination of the milkweed revealed many larvae had been blown to the ground by the gale force winds and had died. Similar conditions occurred at the end of July and on four occasions during August.

Table 1. Number of larvae, pupae and relative percentages of instars of *D. plexippus* during May-September 1984 at Hazelbrook, NSW.

Date	No. of larvae	Relative % of instars				No. of pupae
		2nd	3rd	4th	5th	
26.v. *	100	100	0	0	0	0
9.vi.	90	30	70	0	0	0
23.vi.	82	0	67	33	0	0
24.vi. *	182	0	92	8	0	0
7.vii.	130	0	81	19	0	0
21.vii.	64	0	20	51	29	1
4.viii.	32	0	0	31	69	6
18.viii.	12	0	0	17	83	15
1.ix.	7	0	0	0	100	22
15.ix.	1	0	0	0	100	23
29.ix.	0	0	0	0	0	25

* Denotes introduction of 100 second or third instar larvae.

Observations indicated that larvae were most vulnerable when ecdysis coincided with cold, windy conditions, and invariably died.

Temperatures during the period of study ranged from 1-19°C and daily maxima and minima averaged 12.6 and 6.2°C respectively (Table 2). July was the coldest and most overcast month, while June and August were characterised by similar temperatures and mainly sunny skies. Strong winds were common during July and August but June was mainly calm (Table 2).

Table 2. Climate data for Hazelbrook NSW, June-August 1984. Days were recorded as "sunny" if there were more than 4 hours of sunshine; days were recorded as windy if winds exceeded 20 km/h for more than 1 hour.

	Temperature °C				No. of sunny days	No. of windy days
	Maximum		Minimum			
	Range	Daily mean (±SE)	Range	Daily mean (±SE)		
June	9.5-17.5	13.5 (2.2)	4.5-11.0	6.9 (1.4)	22	2
July	6.0-13.5	10.5 (1.8)	1.0-8.0	4.9 (1.6	17	16
August	10.0-19.0	13.9 (2.5)	3.0-10.0	6.8 (1.8)	25	22
June-August	6.0-19.0	12.6 (2.7)	1.0-11.0	6.2 (1.8)	64	40

Discussion

Overwintering in the Blue Mountains poses considerable problems for the survival of larvae of the monarch butterfly. Whilst cold-cool (0-12°C) conditions (e.g. June) alone do not appear to drastically threaten survival and development of larvae, their occurrence in combination with prolonged exposure to strong winds (e.g. August) produces substantial mortalities. This mortality may have been caused by a wind chill effect, and/or an inability by larvae to recolonise host plants after being blown to the ground. Despite cool conditions, calm and sunny weather in June produced good larval development and excellent survival. An estimated one third of the population progressed from second to fourth instar. This was most likely facilitated by the predominance of sunny days which enabled larvae to elevate body temperatures substantially, thus accelerating development. Winter monarch larvae exposed to sunshine under calm conditions can achieve body temperatures 10-22°C higher than ambient (James 1986). However, even light winds drastically reduce solar heat gains (May 1979). The sustained windy conditions during August produced devastating mortalities and development of survivors was minimal. Even larvae that pupated successfully in late August-September eventually died, indicating that irreversible physiological damage was suffered by the larvae.

The southerly aspect of the garden, despite a certain amount of protection provided by the nearby mature bushland, undoubtedly contributed towards its unsuitability as an overwintering site for *D. plexippus* larvae. It seems likely that reduction of the chill factor by adequate buffering from strong winds would allow good overwintering survival of monarch larvae in the Blue Mountains, provided abundant sunshine was available. Due to air circulation from lower elevations and tree cover, many lower-mid elevation localities in the Blue Mountains are relatively frost-free, allowing survival of the frost-sensitive *G. fruticosus*. In the Sydney basin, the most successful winter breeding populations of *D. plexippus* invariably occur on north facing slopes (James, unpub. obs.) and such situations would offer the best opportunity for survival of overwintering larvae in the Blue Mountains.

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